Report 95-121

Runaway Wagons

Raupunga (near Wairoa)

11 December 1995

Abstract

On Monday 11 December 1995 at about 0800 hours 20 LPA wagons loaded with roading aggregate rolled out of the loop at Raupunga onto the main line and ran down a 1 in 50 grade to Maungaturanga viaduct approximately 1.5 kilometres away. A painting gang working on the viaduct were forced to take urgent evasive action. The wagons came to rest a further 1 kilometre away on a 1 in 50 ascending grade and rolled back to the bridge. The causal factor of the main line runaway was unloading wagons on a crossing loop on a grade with no protection to stop runaway wagons entering the main line.

Safety deficiencies addressed in the report are the adequacy of the safety system meant to avoid such uncontrolled runaways on to main lines.

Transport Accident Investigation Commission

Rail Incident Report 95-121

Train type and number:	Rake of 20 LPA wagons
Date and time:	11 December 1995, 0800 hours
Location:	Raupunga, 262 km, Palmerston North-Gisborne Line (22 km south of Wairoa)
Type of occurrence:	Runaway wagons
Persons on board:	Nil
Injuries:	Nil
Nature of damage:	Minor track damage
Investigator in Charge:	R E Howe

1. Factual Information

1.1 On 11 December 1995 contractors were unloading roading aggregate from Tranz Rail Limited (TRL) railway wagons on the loop at Raupunga. Unloading was by means of a clamshell to transfer from the LPA wagons to a truck and trailer unit.

1.2 11 December was the first day of this operation at Raupunga. Although Wellington area roading aggregate had been railed to the Hawkes Bay area for some time, previous demand had required unloading at Eskdale (near Napier).

1.3 TRL had placed 27 loaded wagons into Raupunga loop prior to unloading commencing. Seven of these wagons were placed on 5 December (refer Figure 1) and at time of placement were reported as having three handbrakes applied and a piece of wood placed under the wheel at the north end. On 8 December a further 20 wagons were placed into Raupunga from the north end by train 664. The locomotive engineer (LE) doing the ground shunting for train 664 watched the rake[1] of 20 contact the seven standing wagons and was sure the hook had dropped, although he did not specifically check that this was the case. To enable the locomotive of train 664 to clear the insulated joint (IJ) at the north end and thus switch off the level crossing alarms the LE stated it was necessary to propel the original wagons approximately 25 m south. The LE on the ground noted there were three handbrakes applied on the original seven wagons and then applied the first three handbrakes at the south end of the rake of 20 dropped off. Air brakes were reported as applied before the rake was uncoupled. The final position of the 27 wagons as reconstructed from reports is shown in Figure 2.

1.4 The grade on the loop and through the loop to the main line at the north end of Raupunga is shown in Figure 3.

1.5 Site investigation of this incident commenced 14 December 1995[2] by which time all wagons involved in the incident had been unloaded and dispatched to various localities. The following sequence of events involving wagon movements and positions and in particular handbrake positions are based on the reports of contracting staff and TRL staff involved.

1.6 Three contracting staff were on site on the day with an operator in charge who had previous experience in unloading wagons at other localities (operator A). There were no TRL staff on site. Unloading commenced at approximately 0730 hours immediately north of the loading bank (refer Figure 1). Following some initial instruction by operator A who partly unloaded the seventh wagon from the south end (wagon 7), operator B took over the clamshell operation. Operator A then stated he walked down the rake of wagons to make sure handbrakes were applied. He could not recollect how many, if any, were already applied but stated he applied seven.

1.7 On returning to the unloading area he joined operator C who was shovelling the last of the aggregate from wagon 7. Operator B was unloading wagon 6 by clamshell.

1.8 Wagons 7 and 8 were in contact and assumed by the contractors to be joined together by the hook.

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[1] A rake is a number of vehicles connected together (may be part of a train).

[2] This incident was initially reported at 1115 hours on 12 December 1995 and was formally confirmed to TAIC at 1530 hours on 13 December 1995.

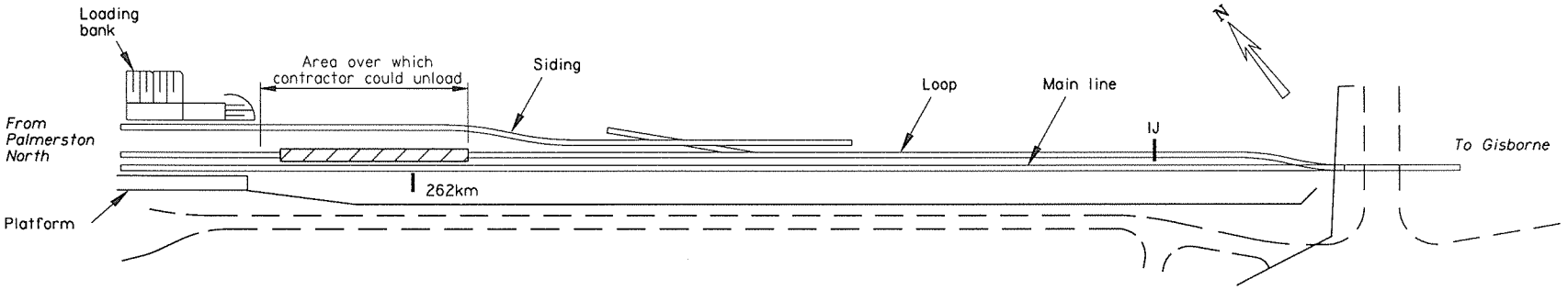

Figure 1
7 wagons as placed 5/12/96

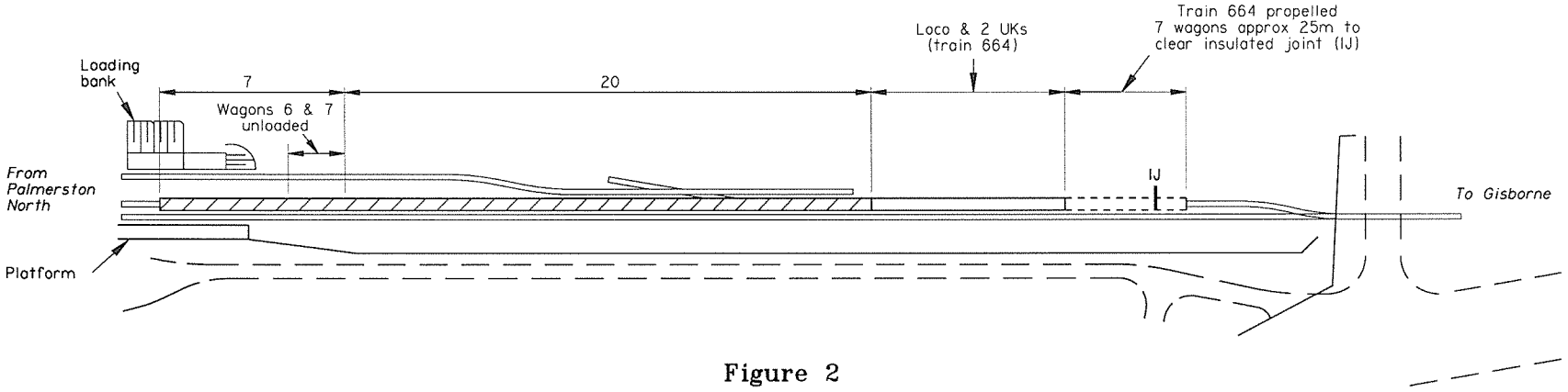

Figure 2
Position of wagons following shunting 8/12/96

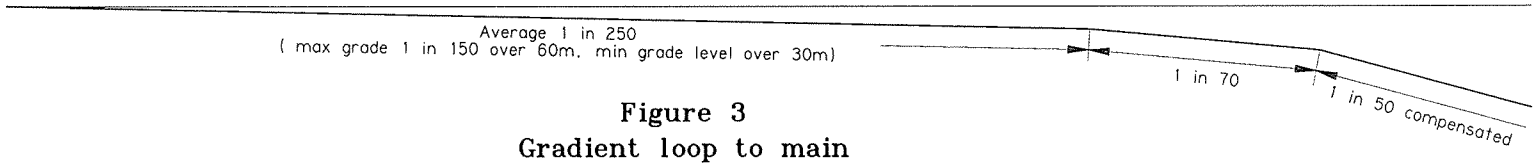

Figure 3
Gradient loop to main

1.9 At approximately 0800 hours unloading was proceeding when a gap opened between wagons 7 and 8 as the 20 loaded wagons at the north end with an all up weight of approximately 500 t started rolling down the grade towards the north end points. The two operators shovelling aggregate jumped from the wagon they were unloading and ran after the retreating rake of wagons to attempt to stop them. Operator C remained on the left hand side of the rake and dropped handbrakes. Operator A commenced on the right hand side of the rake but stated he crossed between moving wagons a number of times as he dropped handbrakes on both sides. Approximately eight handbrakes were reported as dropped before the speed of the wagons required them to stand clear. An attempt to slow the rake by applying a wooden stanchion to the rail had no effect.

1.10 The trailing turnout from loop to main line at the north end of Raupunga was set for traffic through the main line and did not give an uninterrupted passage to the wagons approaching the main line from the loop. The wagons ran through the switch forcing the switch rail aside and causing damage to the switch and rodding before entering the main line and descending the 1 in 50 grade towards Bridge 240 (Maungaturanga viaduct) at the bottom of the grade at 263.552 km, some 1.5 km from Raupunga.

1.11 A gang of painting contractors was working on Bridge 240, and shortly after 0800 hours were proceeding from their hut at the south end of the bridge across the bridge to their work site on the viaduct piers.

1.12 The through plate girder bridge was equipped with a continuous walkway on both sides, intended to provide safe footing but not keep users clear of moving trains. To be clear of the track it was necessary to take refuge towards the bridge girder when required.

1.13 Three painting contractors were on the bridge as the wagons exited the 150 m radius right hand curve immediately preceding the bridge. The nearest man was approximately 12 m from the south end of the bridge, walking on the left hand side with his back to the wagons. He heard the wagons as they reached the bridge end and immediately jumped aside and sat up on the bridge girder as the wagons passed by. The contractors estimated the speed of the wagons at approximately 50 km/h. The other two painting contractors were further on to the bridge and had adequate time to take up a safe position.

1.14 The wagons continued up the 1 in 50 ascending grade on the north side of Bridge 240 eventually coming to rest at approximately 264.5 km and then running back down the grade towards Bridge 240 and coming to rest with approximately 17 wagons on the 1 in 50 grade at the south end and three wagons on the bridge.

1.15 The painting contractors stated they applied the first four handbrakes on the north end of the rake as it came to rest.

1.16 The TRL Clerk Of Works (COW) supervising the painting contractors arrived at Bridge 240 at approximately 0820 hours and noticed "three or four" handbrakes applied at the north end of the rake. He stated he looked up the right hand side of the rake but did not notice any other handbrakes on. Eighteen of the 20 wagons could have been seen from his stated position. He did not look up the left hand side of the rake. (LPA wagons are equipped with one lever type handbrake and for a rake of wagons the lever would occur randomly on the left hand or right hand side.)

1.17 The TRL track gang were on site at the bridge at approximately 0830 hours and a further five handbrakes were reported as being applied to the standing rake at this time.

1.18 The LE rostered on shunting duties for picking up the runaway wagons and returning them to Raupunga stated all air brakes had been bled off and that 20 handbrakes were on hard and required to be released. Of these, three were reported as right down and required adjustment, 12 were in good adjustment and five were "so, so".

1.19 The weather on the day was overcast with a force 3 (gentle breeze) northerly wind from 340° true.

Operational aspects

1.20 TRL's working timetable in effect 11 December 1995 stated that Raupunga was a Warrant Station in a Track Warrant Control area i.e. a non-interlocked station provided for the crossing of trains.

1.21 The Signalling and Interlocking Arrangements diagram for Raupunga detailed a Warrant Station consisting of a main line, loop and siding.

1.22 TRL advised that there had been no scheduled crossings at Raupunga for a number of years due to problems with vandals and the regular train timetable being operated not requiring crossings there, although work trains had occasionally used the loop facility. A proposal to close the loop and utilise the materials to upgrade the adjacent main line was being considered by TRL although no specific decision had been made or site action taken as at 11 December 1995.

1.23 TRL's Working Timetable for the Palmerston North-Gisborne Line had a standard listing of standing room for 7.5 m wagons on sidings, including crossing loops. Because TRL central operating staff were aware of the intention to close Raupunga loop a recent update to the Working Timetable, in effect 11 December 1995, did not include Raupunga as a locality with standing room for wagons (Raupunga had previously been listed as having a 90 wagon standing crossing loop and a 19 wagon standing No. 1 road).

1.24 The No. 1 road (siding) at Raupunga had not been used for years and as at December 1995 had deteriorated to the extent that access from the loop to the siding at the south end was restricted by Working Timetable entry in effect 11 December 1995. Most of the siding was hidden under heavy growth and covered by aggregate.

1.25 The initial request to TRL to change the unloading point from Eskdale to Raupunga came from the unloading contractor as TRL's client representative. Raupunga siding had been used previously for unloading, albeit some years ago. When TRL became aware of this request it was decided in light of the circumstances detailed in 1.24 to use the crossing loop for unloading. Authorisation for this use came from Network Services in Wellington.

1.26 TRL's Rules and Regulations and Rail Operating Code included the following requirements relating to the control of operations affecting crossing loops and the placement of wagons.

> **Rule 121**
>
> (a) Vehicles Standing at Stations - Except where authorised, vehicles detached from a train must not remain on the main line or crossing loop but must be placed in a siding clear of movements on adjoining lines and the brakes pinned down.
>
> Where stop blocks are provided, vehicles must be placed within them and the stop blocks properly secured.

When authorised by train advice at a station where there is only a main line and crossing loop, a defective vehicle can be left on the crossing loop provided the train crew ensure the vehicle can be adequately secured to prevent it moving.

(b) Vehicles in Siding on Grade - In a siding on a gradient vehicles must be placed close to the stop block or trap points at the lower end of the siding; in automatic signalling areas the vehicles must be clear of the fouling track circuits.

Rule 108

(d) shunting at Unattended Stations - At places where an employee is not on duty, train crew or others who shunt trains must see that all vehicles remaining at such places are properly secured and protected. The Locomotive Engineer is to be satisfied that these duties have been completed before the train departs.

Rule 117

(a) Air brakes must not be relied upon to secure a train or any portion of a train when the locomotive is detached.

The employee detaching a locomotive or portion of a train must first apply sufficient hand brakes to secure the train or remaining portion stationary in the event of the air brakes releasing.

Rail Operating Code - Section 7
Rules and Regulations 15.1

The objective of rules and regulations generally is to lay down what experience has proved to be the best course of action in specified circumstances.

The first aim of NZRL Rules and Regulations is safe working, the second is uniform adoption of the best standards of working and the third is dissemination of sound working methods.

A careful study of our Rules and Regulations reveals that they contain not only specific directions for particular cases, but also guide lines which can be adapted to other situations. When these other situations occur, the Officer Controlling Train Running is required to issue suitable instructions to cover the circumstances. Therein lies an important part of the duties for authorised officers.

However, the most essential requirement is that they have a thorough knowledge of the Rules, Regulations and other operating instructions. They must continually refresh their memory by revision so as direction can be given when required.

As a general practice they will not depart from the rules but, as previously mentioned, situations do arise where circumstances call for special or unusual action. Qualified Officers whose names are listed in the Working Timetable are vested with authority for making suitable arrangements to meet operational problems. While they should generally act within the rules they may find it necessary under certain conditions, to take special action requiring modification of, or variation to an existing rule. In such cases they may do this, subject always to the first essential of "SAFETY", but a train advice which covers the intended arrangements must first be issued to all concerned.

Such train advices must quote the rule number, together with the clause or clauses where appropriate, to be modified, so that operating staff will know exactly what is intended. Recipients of the train advice are responsible for seeing that the instructions contained therein are carried out. The written advice, in addition to being a mandate, is for the protection of trainmen and all others concerned in its fulfilment.

If there is an urgent need special trains may run without the issue of train advices on controlled sections where DLAS, CTC or TWC ONLY are in operation.

Staff affected by the running of these trains must be advised and must act on instructions from Train Control.

Wherever possible alterations to train services or operating procedures should be covered by train advice.

Whatever method is employed a cardinal principle of train running work is that relief measures must not be undertaken until the crew of the train which is in difficulties has first been contacted and made fully aware of the relief measures proposed.

1.27 TRL advised that the authorisation to use the crossing loop at Raupunga for unloading wagons (an exception to Rule 121) was verbally given by a Qualified Officer in accordance with Section 7, 15.1 of the Rail Operating Code, but this was not confirmed by train advice as required by the Code. The action was "formalised" by an appropriate entry to the Track Warrant Control Assisted Computer System (TWACS) indicating the loop at Raupunga was occupied and thus prohibiting the issue of a Track Warrant requiring a crossing at Raupunga.

1.28 The contractor engaged by TRL's client to unload wagons at Raupunga was experienced in such operations, having been involved in similar operations at Eskdale and other localities, including Raupunga, over many years.

1.29 The contractor advised that it was normal to have to move wagons as unloading proceeded and this had been necessary at Eskdale and other localities. Because of damage this had caused to his clamshell when used for this purpose at Eskdale the contractor deliberately arranged for a front end loader to be on hand at Raupunga on 11 December 1995, to allow wagons to be moved.

1.30 Although there were discussions between TRL and the contractor some days prior to the commencement of unloading at Raupunga these had not included agreement on procedures necessary to ensure control of placement, unloading and moving of wagons. TRL were aware that unloading would commence on 11 December 1995.

1.31 The Napier Terminal Manager for TRL stated that he did not expect the contractor to have to move wagons when unloading at Raupunga, although no specific arrangements were made with the contractor to ensure he was aware of this and to ascertain any shunting requirements the 27 wagons at Raupunga loop would require.

1.32 Immediately following the runaway incident TRL carried out the necessary work to reinstate the siding at Raupunga. On 14 December 1995 when the TAIC Investigator in Charge site visit took place loading was being carried out on the siding with protection for the loop and main line provided by the facing points at the north end of the siding.

Painting Contractor

1.33 The painting of Bridge 240 was being carried out by contract under TRL supervision. The TRL COW had defined with the contractor those activities which must be carried out under direct supervision or with protection, and those which the contractor could carry out unsupervised and unprotected. It had been mutually agreed that access across the bridge to work sites on piers fell into the latter category. The TRL COW was not on site at the time of the incident. No temporary speed restriction was in force over the bridge. Curvature at each end of the bridge restricted the maximum authorised speed to 40 km/h.

2. Analysis

2.1 The LPA wagons used for aggregate loading had an all up weight of approximately 25 t i.e. 500 t for the 20 wagon rake. With no handbrakes applied, and assuming a breakaway force for roller bearings of 4.5[3] kg/t, the wagons would have been balanced on a grade of 1 in 222, with a down hill force of 2.25 t balanced by bearing resistance. This is a theoretical figure ignoring such factors as wind and coupling slack in a 20 wagon rake. On the day in question the wind was from behind and at approximately 45° to the rake and it would have applied a downhill force of approximately 0.2 t to the rake. The loop track was in good condition with a standard equivalent to the main line, and track imperfection would have provided little resistance. Assuming the rake of wagons was stretched and all coupling slack was taken up, it is considered that on a grade of 1 in 250 the 20 wagons (unbraked) would have needed little help to start moving. The downhill force of 2 t (grade component) and 0.2 t (wind component) would have been opposed by a theoretical resistance of 2.25 t.

2.2 The applications of handbrakes would increase the resistance to downhill forces. TRL advise that handbrakes on LPA wagons supply a holding force of approximately 0.35 t. This holding force does not meet TRL's design criteria of a force suitable for holding a fully laden wagon on a 1 in 33 grade (the governing TRL grade) but was more than suitable for the 1 in 250 grade at Raupunga. To oppose the unbalanced downhill force derived in 2.1 would have required a theoretical minimum of one handbrake fully applied to achieve balance. Making due allowance for brakes out of adjustment and a suitable 'safety factor' it is considered six handbrakes would have been the minimum number required to be applied on a 20 wagon rake to 'secure the train or remaining portion stationary' (Rule 117).

2.3 For the original seven wagons placed on 5 December 1995 three handbrakes were more than sufficient to 'secure' and for the 27 wagons pushed into position and left (understood to be in one rake by the LE) on 8 December 1995 six handbrakes is considered just sufficient to 'secure'. If the hook between wagons 7 and 8 was not down at the time of placement the three handbrakes applied to the 20 wagon rake is considered insufficient to secure in terms of Rule 117.

2.4 For the rake of 20 to have started moving without a major external influence (e.g. pushed from a front end loader or clamshell arm) would have meant at most one handbrake effectively applied. Reports indicated 10 handbrakes were applied (three by the LE on 8 December 1995 and seven by contractor A on 11 December 1995). Contractor A was experienced in wagon moving and familiar with the need to apply weight by standing on the footsteps on the lever brake to apply. The condition of handbrakes indicated by the report of the LE who picked up the runaways (1.18) indicated a likely 70% efficiency of application. Ten handbrakes applied effectively should therefore have provided a theoretical resistance of 10 x 0.35 x 70% i.e. approximately 2½ t. It is probable that the actual resistance provided by 10 effectively applied handbrakes would have been more likely to be approximately 2 t making allowance for normal wear and tear on brake components. Even at 2 t it is considered inconceivable that the activities stated as being carried out by the contractor at the time of runaway would have overcome this resistance and triggered the runaway.

2.5 As a check on the actual handbrake efficiency on the 20 rake the handbrakes were sufficient to hold 17 loaded wagons on a 1 in 50 compensated grade, on a 150 m radius curve at the bridge following runaway. It must therefore have been capable of providing 17 x 25 ÷ 50 = 8.5 t less 2 t (bearing resistance) less 2.5 t (curve resistance); say 4 t braking resistance. The number of

[3] The 4.5 kg/t breakaway force was advised by TRL. This is higher than most internationally accepted data for roller bearings (3.5 lb/T to 4 lb/T = 1.56 kg/t to 1.78 kg/t typically). Using these figures the wagons would have been balanced on a 1 in 560 grade.

handbrakes applied to achieve this is not known, but even assuming all 20 handbrakes applied then 10 handbrakes fully applied should have provided a minimum 2 t resistance.

2.6 Consideration of the above leads to two possible scenarios:

a. Ten handbrakes were effectively applied as stated and a force of approximately 2 t was applied to the 20 wagon rake, thus overcoming resistance and triggering runaway. It is considered the only way of applying such a force would have been by deliberately shunting down hill with a front end loader or similar, which is not supported by witness statements.

b. Up to three handbrakes were effectively applied and a relatively small force consistent with the unloading operation stated as being carried out was sufficient to overcome resistance and trigger movement. This conflicts with the brake application details supplied by operator A but is considered the most likely scenario.

2.7 TRL's consideration of requirements for the Raupunga operation would have been influenced by their assumption that handbrakes would be applied at all times as they considered the contractor did not need to shunt wagons (despite his specific arrangements to carry out this activity). However the vandalism that resulted in Raupunga being bypassed as a crossing place should have been sufficient cause for concern in leaving loaded wagons for some days on a relatively steep grade with no protection to prevent runaways entering the main line.

2.8 The contractors method of unloading (clamshell to truck and trailer unit) limited his activities to a 16 m workface on the morning of 11 December 1995 (refer Figure 1) due to the restrictions of the loading bank at the south end and the terrain at the north end.

2.9 In recognition of the above limitation the contractor included a front end loader in the plant he supplied to Raupunga on 11 December 1995 to allow wagons to be moved clear of the workface once unloaded, and to move full wagons in for unloading. This would have required uncoupling of wagons and lifting of handbrakes as and when required.

2.10 The obvious means for achieving this, and the means adopted by the contractor since activities were transferred to the siding following the incident, was to unload wagons progressively from the south end moving empty wagons up the grade to the south end of the yard and replacing with wagons from the north end.

2.11 The placement of 27 wagons into Raupunga loop to clear the north end IJ resulted in approximately three wagons being moved to opposite the loading bank at the south end in such a way that access for unloading by the method in use was not possible. The easiest way to gain access to these three wagons was to move the rake of 27 wagons approximately three wagon lengths to the north, i.e. down the grade, and if this had been attempted at any stage on 11 December 1995 a runaway with similar consequences to that which occurred at 0800 hours was almost certain. Contractor A stated that he was aware of the potential effect of the grade in such a movement and he proposed using the front end loader to prepare an area south of the loading bank on 11 December 1995 and to move the three wagons uphill and unload accordingly.

2.12 Although conflicting reports were received regarding the timing, number and effectiveness of handbrake applications for the rake of 20 wagons which ran away it became clear during the investigation that the nature of the activities authorised at Raupunga, and the controls imposed, were such that the likelihood of a runaway wagon/wagons was high, and no protection was in place for the main line.

2.13 Once the wagons were moving there was no physical protection in place to stop runaways entering the main line. Rule 121(b) refers to the stop block or trap point at the lower end of a siding on a grade. No such precautions were taken for the loop at Raupunga.

2.14 Once the 500 t rake was moving there was very little chance of stopping it by applying handbrakes. The handbrakes on the LPA wagons were designed to hold a wagon at stop and to be applied when the wagon was stationary. They were not intended to stop a heavily loaded moving wagon or rake of wagons.

3. Findings

3.1 There was no indication at the time the use of the loop at Raupunga for unloading aggregate was authorised by TRL that there was any practical consideration of the hazards associated with possible runaway wagons in this specific locality.

3.2 The placement of 27 wagons at Raupunga by TRL without specific agreed procedures for the contractor to unload them safely, created a potentially hazardous situation.

3.3 The contractor's historical and intended method of unloading by moving wagons with his own equipment was not suitable for the operation authorised for the Raupunga loop.

3.4 A runaway wagon or rake of wagons was highly likely under the method of unloading being used.

3.5 In the event of a runaway there was no protection in place to prevent such runaways entering the main line.

3.6 During attempts to stop the runaways a member of the contractor's staff placed himself at significant risk of death or serious injury by crossing between moving wagons when attempting to apply handbrakes.

3.7 The arrangement made between the TRL COW and the painting contractors as to access across Bridge 240 without supervision or protection to work on the piers was practical and did not place the painting contractors at risk in normal operating circumstances.

3.8 The painting contractors were placed at significant risk of death or serious injury by the unexpected arrival of the runaway rake at a speed in excess of that normally authorised, and with no audible warning.

3.9 The braking potential of the rake of 20 wagons was sufficient to have held them in place on the Raupunga loop if fully utilised.

3.10 The grade on the Raupunga loop was such that the 20 wagon rake was near the point of balance with no handbrakes applied and required only a small force to trigger runaway.

3.11 Conflicting reports on the number of handbrakes applied and the uncertainty as to the effectiveness of their application leaves some doubt as to the nature of the force which was required to initiate the runaway.

3.12 It is considered most likely that the rake of 20 wagons had no handbrakes effectively applied prior to the runaway and that the runaway was initiated by clamshell operation when unloading the adjacent seven wagons.

4. Safety Recommendations

4.1 As a result of the investigation of this incident, it was recommended to TRL on 11 January 1996 that it:

> Reviews the adequacy of the elements of the safety system which failed to prevent unsupervised unloading of wagons on a grade in circumstances where no physical protection from any resulting runaways was provided for the adjacent main line, and take appropriate steps to avoid a recurrence. (002/96)

4.2 TRL responded to the Safety Recommendation on 7 February 1996 and 4 March 1996 advising, inter alia, that:

> The safety recommendation is considered to have been superseded as Tranz Rail Ltd's internal investigation of this occurrence has reviewed the operating process of unloading wagons in similar circumstances and appropriate action taken.
>
> Immediate action was taken by Tranz Rail Ltd to prevent a similar occurrence at Raupunga.
>
> For completeness Tranz Rail Ltd's action following this occurrence was to "review the operating procedures and the process for the use of station loops as wagon storage, loading or unloading of wagons by other parties and continue to maintain the security and safety for the mainline operations".
>
> As a result Tranz Rail considers the Safety Recommendation has been overtaken by completion of our own action.

5. Safety Actions

5.1 Immediately following the runaway incident TRL re-established the siding at Raupunga and transferred unloading from the loop to the siding.

5.2 On 18 January 1996 TRL issued a semi-permanent Train Advice amending Rule 121(a) from Sunday 21 January by adding an additional instruction:

> Operating Rules (General)
> 121(a) Vehicles Standing at Stations (additional instruction)
> When a crossing loop is to be used for accommodating wagons for loading/unloading purposes or accommodating other vehicles for a specific purpose permission must be obtained from the Network Control Manager who is to arrange for the protection of the main line and the necessary train advice to be issued.

5.3 Working Timetable amendments have been issued recognising the reinstatement of the siding access and the available standing room on the loop and siding at Raupunga.

21 August 1996

M F Dunphy
Chief Commissioner